INDUSTRIAL PROCESSING INVESTMENT AND DEVELOPMENT FOR THE FISHERIES OF LAKE VICTORIA: PRESENT AND FUTURE CONCERNS

BY

W.M. SSALI, J.E. REYNOLDS,

& R. OGUTU-OHWAYO

FOR

THE NATIONAL SEMINAR ON THE MANAGEMENT OF THE FISHERIES OF LAKE VICTORIA, 6-8 AUGUST, JINJA, UGANDA.

W.M. Ssali
Dept. of Fisheries
P.O. Box 4
ENTEBBE, UGANDA
JINJA, UGANDA

J.E. Reynolds
FISHIN Project
FAO/UN
P.O. Box 521
KAMPALA, UGANDA

R. Ogutu-Ohwayo
UFFRO
P.O. Box 343
JINJA, UGANDA

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1. INTRODUCTION

The purpose of this paper is to call attention to recent developments in the industrial fish processing sector linked to Lake Victoria, and to consider their implications for the present and future state of the fisheries in both techno-environmental and socio-economic terms. The paper begins with a review highlighting earlier experiences with fisheries commercialisation in and around the Lake. It concludes with some specific proposals for actions aimed at averting or at least minimising the negative impacts of, and encouraging or at least consolidating the benefits associated with, the current proliferation of industrial processing enterprises.

2. BACKGROUND: THE EARLY FISHERIES REGIME

2.1 Subsistence and Artisanal Fishing

The evolution of the Lake Victoria fisheries from the early years of this century to the late 1970s, when radical changes in species composition began to be witnessed, is well documented in a number of sources.[1] For most of its documented history the fisheries have featured the activities of myriad small-scale local operators, processors, and traders. Following the introduction of the gillnet (as early as 1905 in Kisumu District of Kenya, and around 1910 in the Ugandan part of the Lake), developments in all the territorial sectors of the Lake (Kenya, Tanzania, and Uganda) more or less followed a common course of development. There was rapid commercialisation of effort by small canoe fishing units comprised of from two to five crew, and widespread adoption of the new nets (first made of flax and cotton and later of synthetic fibre) for use mostly in inshore waters. Although a wide variety of species were fished, most effort concentrated on the native tilapia *Oreochromis esculenta*, and from the 1950s the introduced *Oreochromis niloticus*. Even the earliest reports on the Lake comment on localities in which serious to critical over-exploitation of the resource was occurring.

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1. These are cited in Reynolds and Ssali (1990), from which this background description has been drawn.

2.2 Traditional Handling, Processing and Marketing

Methods of local fish handling, processing and marketing have undergone little transformation over the years. Movement of fresh fish away from landing centres has always been restricted by high ambient temperatures compounded by slow transit times from net to beach to consumer, though the situation has improved dramatically with the development of road and rail infrastructure and the increasing use of bicycles and motor vehicles.

By far the greatest volume of fish harvested from the Lake was preserved in some form to allow storage over longer periods, and delivery over longer distances. Most of the tilapia catch was cured either by simple hot-smoking over open fires, or by being split and dried in the sun. Smoking and sun-drying remain the principal means of processing fish at local landing centres to this day. Various attempts to improve the efficiency of traditional smoking kilns have been made through projects conducted under the auspices of the Uganda Fisheries Department (UFD), but the basic process remains the same: fish are placed on wire mesh or other types of grills over a slow fire and allowed to cure in the heat and smoke for varying lengths of time, usually one to three days. The resulting product can last without spoilage for a period of from a few days up to several weeks, depending on how much moisture content has been removed.

2.3 Mechanised/Industrial Fishing

The idea of a mechanised trawl fishery on Lake Victoria reportedly goes back ~~as early as~~ 1950, when scientists at the East African Freshwater Fisheries Research Organization (EAFFRO) suggested that the large stocks of *Haplochromis spp.* could be exploited in this way (Jackson 1972). In 1953, the Uganda Development Corporation ~~is reported to have started~~ attempted a trawling operation to exploit *Bagrus*, *Mormyrus*, and *Haplochromis* in the waters around Dagusi Island, ~~off of South Busoga in what is now the Tororo Fisheries Region~~. The scheme proved a complete failure for a combination of reasons, including: lower than anticipated catches of important species, delays in obtaining needed equipment, spoilage of cured product before reaching mainland markets, and poor market for the main part of the output, i.e. sun-dried *Haplochromis*.

Various subsequent efforts at research and development for a trawling and processing industry in Uganda based on haplochromines also came to nought. It should be noted, however, that a major project along these lines was implemented in Tanzania. Based on exploratory work conducted at the Nyegezi Fisheries Institute, a fish meal plant of 60 tonnes wet fish/day capacity was erected near Mwanza. The Nyanza Fishing and Processing Company, as it was known, began operations in 1975 with raw product being supplied by a small fleet of trawlers. But

the enterprise proved to be a great disappointment, as haplochromine stocks soon collapsed under the combined pressure of heavy trawl fishing and predation by the Nile perch, then rapidly colonising the waters around Mwanza.

2.4 Industrial Handling, Processing, and Marketing

2.4.1 Early developments

During his field investigations of the Lake Victoria fishery in 1927, Graham (1929) noted that consignments of ice-chilled tilapia were being shipped to points along the rail line from Kisumu in Kenya. Ford (1955) reported that the shipping of gutted and iced fresh tilapia by rail from Kisumu was still being practiced in the early 1950s.

Nothing similar to the Kisumu system of chilling and shipping catches on a commercial basis existed in the Uganda sector of Lake Victoria until around the late 1960s, when the UFD installed a pilot ice-making plant at Masese, near Jinja. A sister plant was installed in Soroti to serve the Lake Kyoga fishery. The plan was for local fishmongers to draw supplies of ice from the plants to keep their shipments chilled and fresh until reaching markets. Neither plant operated for more than a few years. The system proved unworkable due to frequent mechanical breakdowns, the reluctance on the part of traders to use the facilities, and the lack of suitable packing containers to carry iced fish. (UFD Annual Report 1971).

2.4.2 Western Uganda fish processing plants

The main pioneering venture in fish processing on an industrial scale within Uganda actually took place at some remove from Lake Victoria. This was in the form of the well-known TUFMAC (The Uganda Fish Marketing Corporation) plant located in the western part of Uganda at Lake George, within the Kichwamba Fisheries Region. The plant was started in 1950, and received supplies of fresh fish from Lake George and the Kazinga Channel-Lake Edward fisheries. TUFMAC became best known for its frozen fillets of tilapia, though it also carried out a substantial trade in whole frozen fish and salted and smoked products, and produced limited quantities of fish meal as well. Following the precedent set by TUFMAC, two other fish processing plants were established in the Kichwamba Region. Like the older concern, they produced essentially for the East African market. One company started to develop contacts in the United States and sent frozen tilapia fillets on a trial basis as far as Chicago. However, both concerns had ceased business by the end of 1972 due to the deteriorating economic and political situation in Uganda.

In the meantime, TUFMAC had been experiencing mixed fortunes over the plant closed down for good in 1977. Its failure can be attributed to a variety of reasons, including an overly ambitious scheme of operations at the outset, the imposition of its buyer's monopoly for Lake George catches which caused friction between the company and local fisherfolk, and episodes of outright mismanagement.

2.4.3 Tilapia fillet plants in Kampala

It was not until around 1973-74 that industrial type processing of fish got underway around Kampala. Frozen Foods Ltd. was established in the industrial area of the city and operated with equipment transferred from one of the old plants in the west. Tilapia were obtained from nearby landings on Lake Victoria, and frozen fillets were produced for the local supermarket and hotel trade and, to a limited extent, for export to Nairobi. Another and much smaller-scale concern, Afro-Fish, was also launched around this time. Afro-Fish also produced frozen fillets of tilapia for the local supermarket trade, but obtained its supplies of fresh fish from Lake Wamala.[2] A third company, FishCo, reportedly was also engaged in the frozen tilapia fillet trade on a small scale during this period.

None of these Kampala-based concerns was able to continue in business for very long, given the worsening situation of misrule and economic disarray plaguing the country. All operations had ceased by around 1976 or so. The ensuing period of strife and insecurity which lasted up until the mid-1980s was characterised by a virtual collapse of the national economy and activity in terms of fisheries industrialisation was nil.

3. RECENT DEVELOPMENTS: THE NILE PERCH SUCCESSION

3.1 Trends in Catch Levels and Species Composition[3]

The late 1970s and early 1980s witnessed some remarkable transformations in the fisheries of Lake Victoria, attendant upon the flourishing stocks of the introduced predator fish Nile perch, *Lates niloticus*, as has been documented in some detail by Reynolds and Greboval (1988). In general the pattern has been the same for all the territorial sectors of the Lake, with Nile perch beginning to show in the catches at very low and

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2. A fairly large but shallow body of water some 50km to the west of Kampala which hosted a quite productive fishery until overexploitation led to its collapse in the late 1970s.

3. The descriptive account in this section has been derived in part from Kirema-Mukasa and Reynolds (1990) and Orach-Meza *et al.* (1989).

inconsistent levels initially, and then within the course of a few years becoming quite a significant part of the annual harvest and soon establishing itself as the predominant commercial species. This process took place somewhat earlier in the Kenyan (late 1970s) and Tanzanian (early 1980s) portions of the Lake than it did in Ugandan portion (mid-1980s), even though it was along the Uganda shoreline that *Lates* was first introduced in ~~the late 1950s and~~ early 1960s. The delayed appearance of Nile perch in Ugandan catches may have been due at least in part to the shortage of fishing gear within the country during the late 1970s and early 1980s.

Despite the predictions of ecological and economic disaster raised by some observers over the Nile perch introduction, the new fishery regime has brought immense benefits to the fisherfolk and consumer populations of the Lake Victoria region. This last point warrants particular emphasis in the case of Uganda. From a human nutrition point of view, the sudden availability of vast quantities of high quality animal protein from Lake Victoria must be seen as one of the more fortunate events in the recent history of the country -- a history that has otherwise been marked by widespread instability and severe disruption in food production both at the farm and processing/manufacturing levels. The bounty of the new fishery for Nile perch proved so great that it could partly compensate not only for setbacks in the ~~agriculture~~ and livestock sectors, but for the temporary displacement or decline of the contribution of the other major fisheries of the country.

Although stocks of certain species, especially amongst the haplochromines, have been seriously affected by Nile perch predation, those of some other commercially valuable fish have been able to thrive. Catches of the small pelagic *Rastrineobola argentea* or *mukene* and the introducted tilapia *Oreochromis niloticus* have both shown substantial increases in all parts of the Lake within recent years. It is still an open question though if other species stocks will be able to recover to some extent, if at all, as the lacustrine system continues to adjust itself. Of overriding importance for commercial fisheries interests, however, is the sustained presence of strong stocks of Nile perch, tilipia, and *mukene*. This is also very much an open question.

3.2 New Industrial/Mechanised Fishing Ventures

The Nile perch boom has stimulated renewed interest in mechanised trawling in all sectors of Lake Victoria, though operations have so far been minimal in the Ugandan waters. Trawling for perch got underway in Tanzanian waters fairly early on, using units of the ~~old~~ Nyanza Fishing and Processing Company that had been rendered idle after the collapse of the *Haplochromis* fishery. Also a number of wooden and steel-hulled trawlers have been built in Government and private boatyards since the mid-1970s, so that

Tanzania currently has the largest trawling fleet on the Lake. In Kenya, the modern trawler fleet developed on a much smaller scale, amounting only to three or four units. Thus far the only development in Ugandan waters has been in the form of a pair trawl operation mounted by the Sino-Uganda Fisheries Joint Venture Co. Ltd., based in Entebbe. Two sets of pair trawlers run from the base at Entebbe Pier.

Trawling unit operators, whatever their stated intentions, tend to fish the same shallow inshore and nearshore grounds used by artisanal canoe fishers -- grounds that are familiar and known to produce catches. The incompatibility of these two fisheries is obvious, and it should come as no surprise that in every sector of Lake Victoria where trawling has been permitted, an outcry has been raised by local fisherfolk. Immediately the Sino-Uganda operations began in September 1989, for example, complaints began to be registered from irate individuals who claimed that the trawlers were pulling through their sets and destroying large quantities of gillnets. These complaints have continued almost without pause from every area the trawlers have visited.

It is difficult to see how the coexistence of mechanised trawling and artisanal operations can be managed. The artisanal sector, it must be remembered, constitutes the primary productive force in the industry -- its very core. Moreover, evidence from elsewhere on the Lake shows that trawling units, even if financially viable, are greatly outperformed by the established canoe-based gillnet fishery in terms of the wider economic benefits which accrue. Fundamental doubts about the wisdom of these mechanised operations therefore remain (Reynolds and Greboval 1988).

3.3 New Industrial Handling and Processing Ventures

Soaring production levels for the Lake have offered new commercial opportunities within the post-harvest sector, and there has been no lack of response from various private interests and public agencies. Just as in the case of the new mechanised trawling ventures, there has been very little in the way of consultation or cooperation between the riparian states with regard to the way large-scale commercialisation of fish processing ought to be dealt with at the policy level, and planned and managed in practice. Each country has instead tended to keep its own counsel as to how developments should be allowed to proceed. This is most unfortunate, as crucial shared resources are at stake. It is moreover unwarranted, since a consultative mechanism has been in place for some years, in the form of the Committee for Inland Fisheries of Africa (CIFA), Sub-Committee for the Development and Management of the Fisheries of Lake Victoria.

The growth of fish processing plants has been most apparent in Kenya, which enjoys the advantage of good communications and easy product evacuation routes from the lakeshore to Nairobi and the port of Kilindini, Mombasa. In the early 1980s there were only a few industrial fish handling and processing houses in that country. Now, a decade later, they number around 20. Many are situated in the Kisumu area, but there are some in Nairobi and Mombasa as well. All are dealing in Nile perch fillets as a primary or secondary item of production (Greboval 1989). A consequence of this rapid expansion of industrial processing capacity is that demand for raw product has skyrocketed. This may well have an adverse effect on local processors and traders, who are also seeking fresh fish from landings around the rather limited zone that constitutes Kenya's Lake Victoria fishery (only about 6% of the total Lake surface lies in Kenya). It is also a circumstance which is encouraging rampant smuggling of catches from Uganda waters to nearby landing sites in Kenya ~~(Reynolds, Wadanya, and Nyeko 1989~~ (Kirema-Mukasa and Reynolds 1991).

In the Tanzanian sector of the Lake, recent industrial processing initiatives have been slower to take off, largely for reasons of geographical remoteness and infrastructural problems. As of the late 1980s, however, several entrepreneurs were known to be active in shipping out consignments of chilled and frozen Nile perch fillets and whole fish from the Mwanza and Musoma areas via road, rail, and air routes to Dar es Salaam. One firm had started canning operations on a pilot basis (Reynolds and Greboval 1988; Reynolds, pers.obs. 1989).

Current industrial-level fish processing activity in Uganda is mainly directed towards production of high-quality, high-value table fish products for export, though there is some use of small-sized fish in the manufacture of cereal meal supplements and animal feeds. By the first quarter of 1990 there was a total of five fish processing plants (Reynolds and Ssali, 1990) with a maximum processing capacity of about 15,000 tonnes of raw material per annum. By the end of 1991 there will be more plants with a total capacity of about 40,000 tonnes of raw material per annum. Furthermore if all pending applications for additional processing plants were to be allowed, the total raw material requirement would amount to about 60,000 tonnes p.a. (UFD Records 1991). It is significant to note that all these plants are or would be based on L. Victoria-Uganda, targeting at Nile perch and tilapia only.

The establishment of this high level of processing plant capacity has multiple techno-environmental and socio-economic implications. These will now be considered in turn.

4. TECHNO-ENVIRONMENTAL IMPLICATIONS

4.1. Increased Demands on Fish Stocks

The establishment of processing plants has caused increased demand for fish over and above the domestic requirements. This has in turn resulted in increasing fishing effort which easily leads to a situation of overexploitation of available stocks. There are already indications that this is a real and present danger, and it is worth appreciating the technical details involved.

Mesh size selectivity in relation to the size of at first maturity for Nile perch, Nile tilapia, and *mukene* on Lakes Victoria and Kyoga has been the subject of recent investigations by UFFRO scientists (Ogutu-Ohwayo *et al.* 1989). As illustrated in Figure 1, a strong linear correlation obtains between the mesh size and the length of Nile perch retained by the gillnet. The same applies in the case of the Nile tilapia, as shown in Figure 2.

For *mukene*, commonly fished with very small-meshed seine nets, the same relationship between mesh size and length of fish retained holds true. This is demonstrated by Figure 3, which shows the frequency distribution of fish retained in the commercial mosquito seine nets of 5 mm and 10 mm in common use on Lake Victoria.

In all cases, it is obvious that the use of smaller-meshed nets will ultimately have a most detrimental impact since they select far more heavily for immature fish than do those of a larger mesh. Yet this practice is becoming increasingly widespread in both the Lake Victoria and Lake Kyoga fisheries (Ogutu-Ohwayo 1991), as is apparent from the prodigious quantities of undersized fish being landed and marketed around the shorelines. This is particularly worrisome for the two major commercial species, *Oreochromis niloticus* and *Lates niloticus*, which between them account for upwards of 90% of the catch on these two lakes. The legally permitted minimum size for Nile tilapia is 28 cm or 11 inches, while that for Nile perch is 46 cm or 18 inches. These lengths of fish would require a minimum mesh size of 127 mm or 5 inches, although the law currently says nothing about permissible net mesh sizes *per se*. It is obvious that urgent action should be taken to rectify this deficiency.

Yet in a situation in which processing plant operators or their agents are now regular customers at several of the major landing points on Lake Victoria, and are bidding for fish right alongside local processors and traders, it is difficult to see how pressures towards recruitment overfishing will subside. Local fish traders, finding themselves in a poor competitive position

vis-a-vis the better capitalised large-scale operators, can be expected increasingly to seek out fish of poorer quality and less market value (including *mukene*), and/or undersized fish. If the latter, then further fishing depletion of the stocks through the use of small-mesh nets and other destructive practices such as beach seines and cast nets will certainly follow (Reynolds and Kirema-Mukasa 1991).

4.2 Water Pollution

Fish processing plants require large quantities of water in their daily routine operations. After use this water contains solid material, dissolved solids (soluble proteins) and detergents, all of which could ultimately find their way into Lake Victoria. If plant effluents do not receive proper treatment, severe localised pollution of the lake will be the result. Although no cases have yet been reported, the situation clearly calls for close monitoring.

4.3 Fish Quality and Reduction of Post-harvest Losses

One of the positive outcomes of the increase in fish processing plants around the Lake is the encouragement that has been given to improved handling practices within the industry overall. In order to successfully compete, particularly in world markets, fish processing plants have to pay particular attention to quality of the raw material. This is the only way to ensure good presentation and acceptance of the final product. As the factories continue to demand high standards for fresh fish and demonstrate willingness to pay premium prices for the same, local fisherfolk will continue to improve their handling practices. This not only benefits the quality of fish available in the country generally, but also will promote a net reduction in post-harvest losses.

4.4 Conservation of Forests

A further positive contribution made by the growth of the industrial processing sector is that it is likely to encourage greater proportions of landed catches to be marketed in fresh form rather than being subjected to some form of traditional processing. As this latter mostly comprises hot-smoking of products to various degrees of moisture loss, significant gains in terms of fuelwood conservation for the country are in prospect (cf. Ssali, Reynolds, and Ward 1990).

5. SOCIO-ECONOMIC IMPLICATIONS

5.1 Generation of Enhanced Earnings

As in the case of the other riparian states, the new fisheries of Lake Victoria have generated huge and unprecedented financial rewards for local fishing operators in Uganda (Reynolds and Greboval 1988; Greboval 1989). This must be regarded as one of the most significant contributions that the introduced species have made: the resource rents that have accrued in a period of less than a decade dwarfs the value of the earlier fisheries regime. It has certainly been a welcome development as far as local fisherfolk and the Uganda Department of Fisheries are concerned. In fact one of the functions of the Fisheries Department is to "formulate and implement integrated programmes aimed at improving the quality of life in the fishing industry" and one of the objectives of the UFD Development Programmes is "to raise the income and standard of living of fishermen who are among the least favoured groups in the country" (MAIF, 1983).

Although fish processing plant investors may be acting more from the motive of private gain than public service, the fact that their businesses are significantly contributing to the attainment of the Department's objectives should not go unremarked or unappreciated.

5.2 Generation of Employment

All fish processing plants need experienced managers, engineers, technicians and technologists as well as a team of less highly trained manual and service workers. In addition to the several hundred direct jobs available in the plants at the present time all of secondary and tertiary employment they generate must also be taken into account. Far greater numbers of people are either wholly or partly employed in support services the plants need to stay in operation, whether in landing site porterage, waterborne transport, packaging, insurance, clearing and forwarding, or other activities.

5.3 Contribution to Forex Earnings

Current Government policy places high priority on the diversification of the country's export commodity base as a means to earn greater amounts of foreign exchange and also to lessen the dependency on traditional items that cannot always be counted on to perform well in volatile world markets. As virtually all the fish processing plants are geared towards exporting most of their products, they are clearly contributing to the realisation of policy goals. The extent of this contribution is still of fairly modest proportions, judging from what is known. For 1990 the value of premium fish product exports to overseas markets was

in the neighbourhood of USD .75 million (BOU 1991). As industry capacity gears up to higher levels, this figure can be expected to show a substantial increase.

5.4 Effect on Nutritional Welfare

Fish has historically made an extremely significant contribution to the nation's nutritional welfare. In the Lake Victoria Crescent zone, where the majority of the national population resides, fish is easily the most abundantly available source of animal protein. But it is enthusiastically consumed in nearly every corner of the country because people find it palatable and relatively cheap. The attraction of low price has been particularly strong in past years in the case of Nile perch. Kirema-Mukasa and Reynolds (1991) calculated protein cost indices for major food items in the Kampala area effective during the last quarter of 1990, and showed that fish and especially the perch performed extremely well against all other forms of animal protein and even against some protein-rich non-meat foods. The situation may now be changing rather dramatically in the reverse direction, however. In the last part of 1990, respective prices for one kilogram of beef, goat meat, chicken, and fish (Nile perch) were Shs.600/=, 700/=, 1200/=, and 300/=. But by the end of the second quarter of 1991, the per kilogram prices for beef, goat meat and chicken had increased respectively to Shs.700/=, 900/= and 2500/= whereas the price of Nile perch had increased to Shs.700/= in Owino Market (Financial Times, 27 June 1991). Such a steep increase in the price of perch may have put it out of reach for lower income households -- a development that would by no means be welcome given the still precarious food security situation among the rural and urban poor of the country.

Several factors may have contributed to the recent hike in the price of Nile perch, but a very likely candidate for a major role is heightened demand for the product at the ex-canoe level, fueled by competition between fish processing plants as each seek adequate supplies of raw material. Assuming a more or less constant level of production, this sort of competition can only provoke an upward spiral in landing site prices. Aside from small-scale local traders, who stand to be marginalised by this sort of bidding process, it is the local consumer who will ultimately have to cope up with the situation -- and probably not very happily.

6. CONCLUSION: CONCERNS FOR THE FUTURE AND PROPOSALS FOR ACTION

In principle, the establishment of fish processing plants in the country over recent years is a positive development. However, it is extremely important that future plans be mounted with extreme caution due to the fact that the factories are relying on a resource which, though renewable, could easily be depleted. Then the whole purpose of the investments -- now with an estimated

worth of between USD 9 and 10 million (UFD Records 1991) -- would be defeated and the country would find itself worse off with the factories than it ever would have been without them. "Sustainability," as always in such contexts as this, is the key word.

6.1 Relations Between Fisheries Agencies and Interests

In order to foster sustained development it is absolutely crucial that good working relationships be cultivated between the various agencies and interests play various roles in fisheries stewardship and exploitation. A suggested delineation of these roles is set out below.

6.1.1 The Fisheries Department

The Department should continue playing a central role in the administration of the fisheries sector. Fundamental to this role are responsibilities for ensuring that policy guidelines are being respected, legal regulations enforced, statistics and other vital information properly collected, compiled and made available to all agencies and parties with fisheries related interests, and effective extension services provided.

6.1.2 Research Institutions

Research is a vital part of the management process for the fisheries industry and the Department must make every effort to foster close collaboration between the various agencies concerned with it, notably UFFRO, the Kajansi Station and the Fish Technology Laboratory. Obviously, there must be regular meetings between the heads of research institutions and senior staff in the Department to decide on research priority issues. Similarly, the research institutions should encourage the holding of seminars, symposia, and workshops on a regular basis so that the results of work being carried out can be given an airing and researchers themselves given a chance to learn about developments and needs in the administration and extension sectors.

An ideal situation would seem to be for the three national fisheries research institutions to achieve a balance between certain areas of specialisation.

Lake and River Fisheries -- UFFRO. The basic role of UFFRO should be consistent with its well-recognised position as the foremost fisheries research establishment in the country. Its remit should remain that of conducting research and monitoring work pertaining to aquatic biology and ecology, fisheries socio-economics, fishing gear development, and stock assessment.

Aquaculture -- Kajansi Research Station. As the principle aquaculture research institution in Uganda the Kajansi Station should carry out research on all aspects of fish rearing techniques, pond management, fish nutrition, and fish pathology. Its research should be aimed at increasing fish production through fish farming. It should also play a strong extension role by working through out-stations to deal directly with fish farmers on technical matters affecting their enterprises; at the same time it should hold a brief to constantly advise the Department on latest developments in the sector.

Fish Technology -- The Fish Technology Laboratory. The principle tasks of the Laboratory at Entebbe should be to conduct research on all aspects of post-harvest fish technology, quality assurance, fish chemistry/biochemistry, and product development. The institution should work closely with fish processing factories particularly with regard to quality improvements and product development. The institution should also assist the Department in setting up standards and codes of practice for fish and fishery products.

6.1.3 The User Sector

Private and parastatal interests are the end users of services provided by the administration, extension, and research arms of the national fisheries agencies. They include fish farmers, lake and river fishers, artisanal and industrial fish processors, and local and export traders. The user interests should demand much more in the way of support and technical backstopping from teh service agencies, but at the same time offer co-operation in devision ways and means of looking after their upkeep.

6.2 Other Outstanding Issues

6.2.1 Proliferation of processing plants

The Nile perch "boom" is Lake Victoria along with recent Government emphasis on fish as a potential source of foreign exchange has generated intense interest in the fisheries sector among investors. Unfortunately the investment started on the wrong footing in that the first potential processors only obtained industrial licences without first referring to the Fisheries Department. Consequently, a number of processing plants were built without guidelines from the relevant authorities. In most instances, plants were constructed first and then technical advice sought later.

Some attempt was made to halt the uncontrolled exploitation of the fisheries resource by the ministerial decision that all future candidates for industrial processing of fish had to be cleared by the fisheries authorities before being issued with industrial licences. In addition, an *ad hoc* Committee on

Fisheries Exploitation was appointed to look into a wide range of issues affecting the industry (UFD Records, 1989). Through the course of its work the Committee has found that there are so many potential investors interested in setting up fish processing factories along the shores of Lake Victoria that the future sustainability of the fishery has become problematical if not threatened outright (UFD Records, 1990; 1991). Considering that presently there is no systematic mechanism to deal with applications for industrial exploitation of the Lake Victoria resources or any other fisheries resources of Uganda, it is suggested that a permanent body be established to serve precisely this function.

6.2.2 "Undocumented" Export of Fish

The smuggling of fish from Uganda, sometimes referred to euphemistically as "informal border trade" or "undocumented export" has reached truly alarming proportions, particularly along and across the waters of Lake Victoria into Kenya. Various estimates place the amount of fresh fish smuggled out of this country between between a low of 40 and a high of 200 tonnes every day (BOU 1991; UFD Reports 1991). The loss of official export revenues and value-added benefits to the national economy must amount to hundreds of thousands of dollars.

While the reasons for smuggling fish may be varied the cash incentive is always closely at hand. The Port Victoria (Kenya) ex-canoe price for fresh Nile perch is now said to stand at KShs. 15/= per kilogram, or roughly the equivalent of UShs 450-500/=. It is believed that other inducements such as the provision of fuel and perhaps even engines by fish buyers on the Kenya side also play a role in keeping this traffic alive and well. And it must be recognised too that any canoe carrying fish across the border to the other shore has space for a full load of any sort of cargo on the way back. Measures aimed at reversing this pattern of "duty-free" trade must therefore seriously address an array of issues. It is proposed that the matter be dealt with from three several angles (cf. Kirema-Mukasa and Reynolds 1991):

- Uganda fish processors (or local fishmongers) should not only continue to strive to offer fisherfolk competitive prices, consistent with the need to overheat landing site bidding, but they should also strive to provide fishing operators in the eastern sector of the Lake with the kind of technical "backstopping" services that seem to be so effectively used by their Kenya counterparts, including advances of fuel, loans or use arrangements for engines, good collection boat contacts, and the like.

- The idea of freeing petty consumer commodities, so popular in cross-border transactions, from possibly overly-burdensome customs procedures and excise obligations should be thoroughly explored.

- Obviously better on-water surveillance and/or law enforcement by the relevant Government agencies is called for.

- Those inclined towards the fish smuggling business either as suppliers to the fish runners or as the runners themselves should be educated about the losses the nation incurs as a result of this kind of trafficking. It seems that few people really understand what stakes are ultimately involved; and indeed there are those who argue that if fisherfolk can reap more reward by selling to there instead of to here, then so much the better for them as a class of people who have traditionally been under-remunerated and poorly served by the wider national society. It follows that Government should make every effort to demonstrate to the fisherfolk that their general welfare is a matter of foremost concern. Such commitment must be shown by establishing development programmes relevant to people's daily needs.

An additional but more extreme measure might be considered in the event that other steps fail to curb the problem, and only if the current mechanised trawling operation will be allowed to continue. The idea would be to create a special trawling zone in the off-shore waters of the eastern part of the lake and transfer the Sino-Uganda Fisheries Company operations solely to that area, the catches to be landed and sold only to licensed traders and plant agents at Uganda ports of call. While much weight of argument can and perhaps should be mobilised against such a scheme, it could conceivably be an effective means to discourage the artificially induced "migration" of fish across the water to collection vans waiting on the other side.

6.2.3 Towards sectoral development

Underdevelopment in the fisheries sector is not only limited to the persons involved in the industry but extends to the related infrastructure. For example one finds that feeder roads to fish landings are in most cases the least maintained, fish landings usually lack amenities such as toilets and fish markets are rarely equipped to handle such perishable product. It is clear that not enough financial resources are allocated to fisheries development particularly in the rural areas. Yet the sector generates substantial amounts of revenue particularly for the local authorities. If some of the revenue were ploughed back directly into the industry considerable development potential would be released. Furthermore, as emphasised earlier on, there

is a strong need to build better ties of service and support between the different parties to fisheries management, on both the official agency and user sides.

It is therefore proposed that some sort of mechanism be considered for pooling and disbursing funds to finance fisheries research and development activities. Such a "National Fisheries Development Fund" could be administered by a Board of Trustees composed of persons from both the public and private sectors. Contributions to the fund could come from industrial processors, artisanal fisherfolk and fisheries-related businesses through various service-user fees or levies. The heads of research institutions could be responsible for ensuring that research funds are properly utilised and for reporting on the same to the Board of Trustees. In a like manner. District Development Committees could be responsible for utilisation of infrastructure development funds in liaison with District and Regional Fisheries Officers and the Board.

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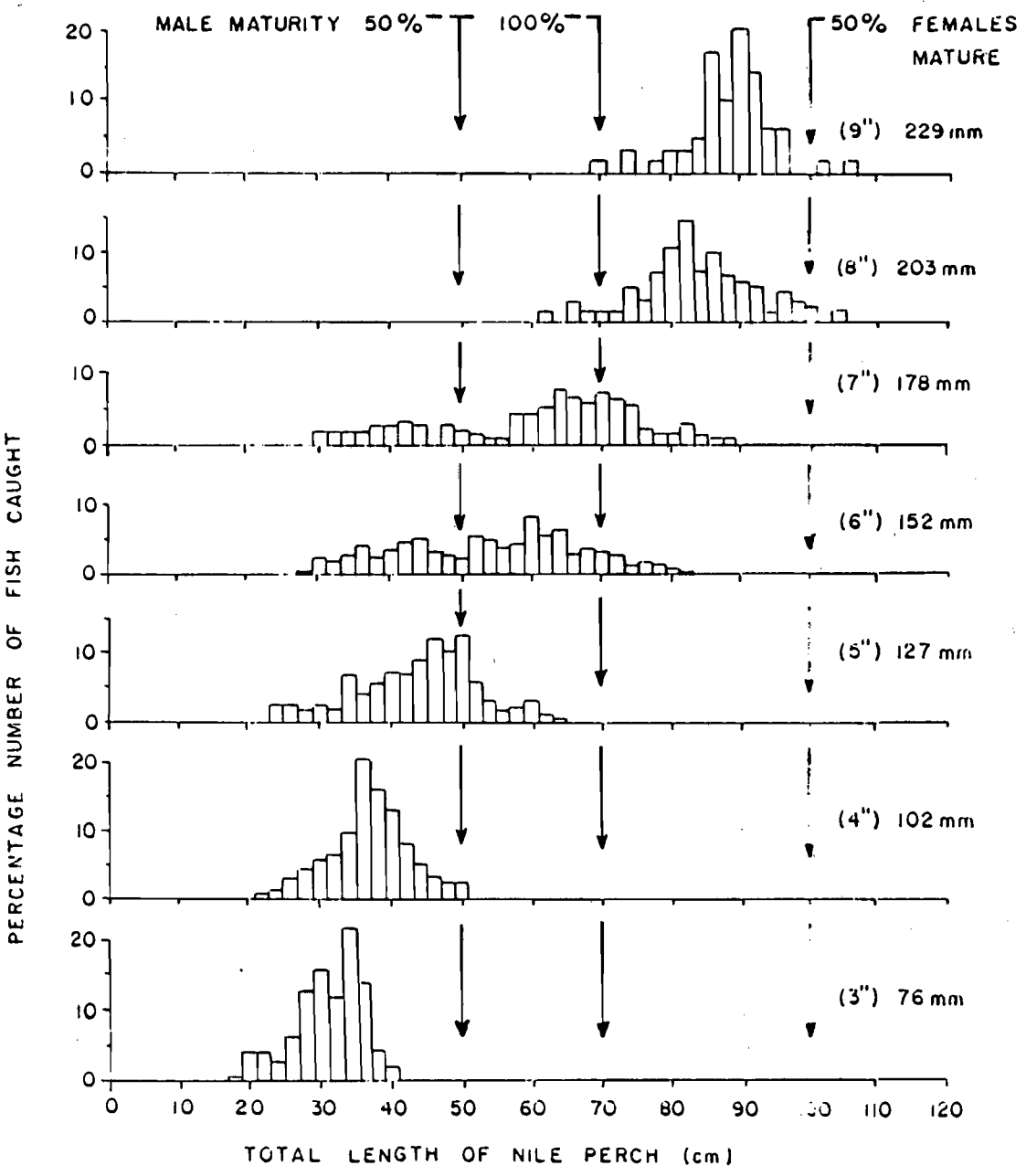

Figure 1. The length frequency distribution of Nile perch caught by gillnets of different mesh sizes expressed as a percentage of the catch for each 2 cm length classes of the fish for each mesh size.

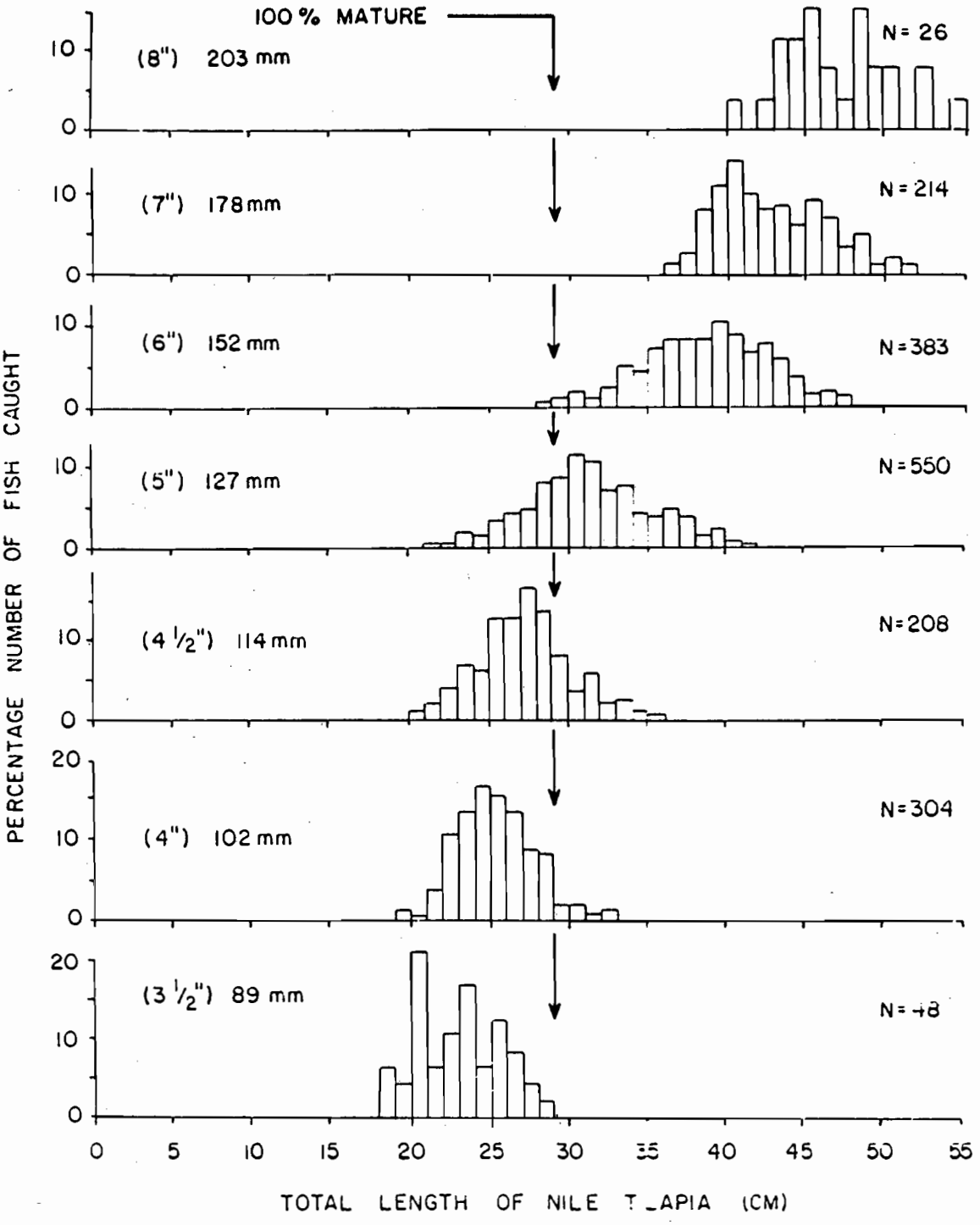

Figure 2. The length frequency distribution of Nile tilapia caught by gillnets of different mesh sizes expressed as a percentage of the catch for each 1 cm length classes of the fish for each mesh size.

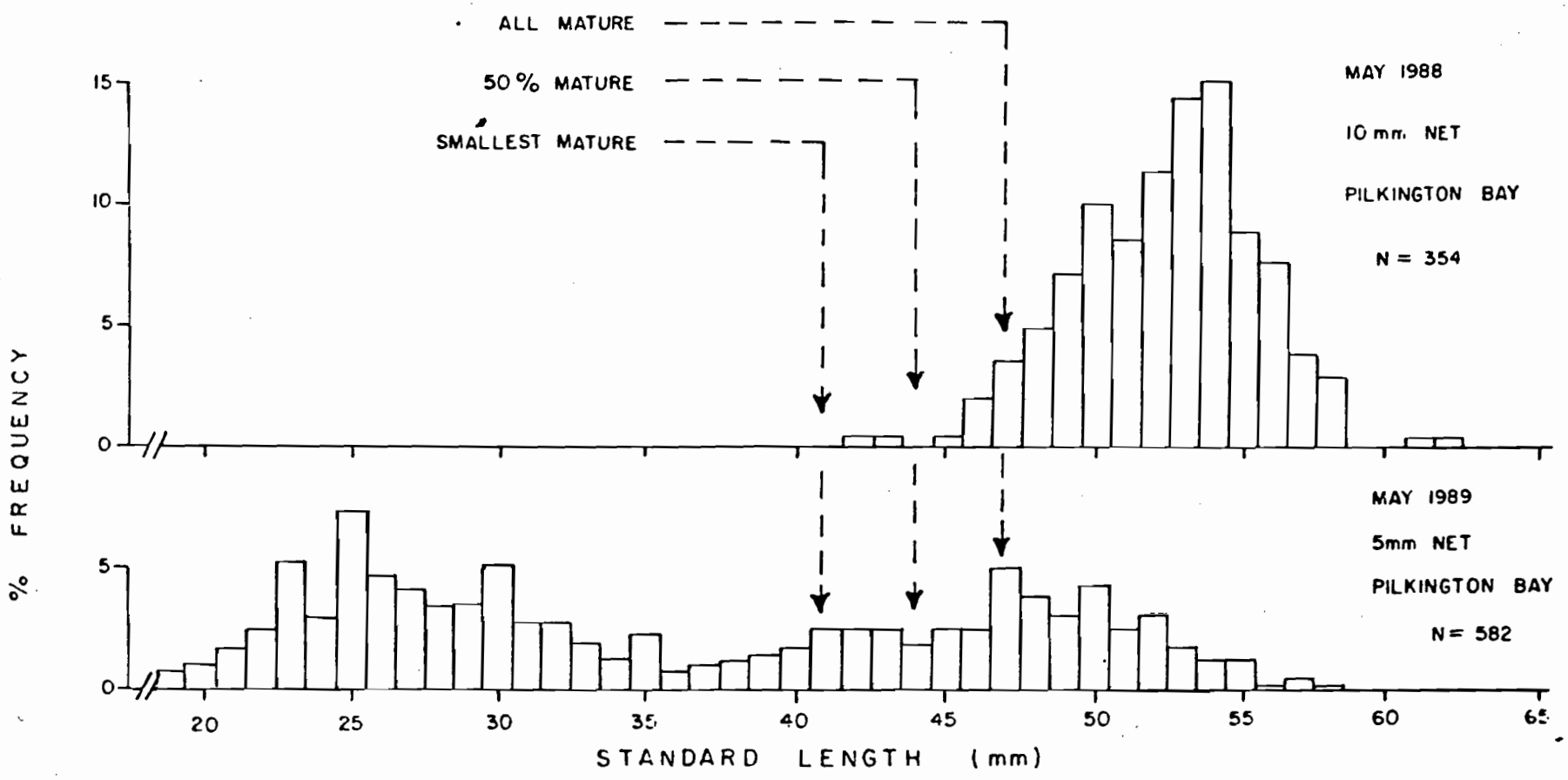

Figure 3. The length frequency distribution of Mukene retained in commercial seine nets in Lake Victoria. The sizes at which 50%, and all fish are mature and those of the smallest mature individuals are indicated.